



Sustainable practices applied in heat treatment processes: literature review and case study

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Abstract

The study is based on a literature review of sustainable practices applied in heat treatment processes, followed by a case study in a company of the area, verifying the applicability and recurrence of these methods.

Key words:

Heat treatment, sustainability, energy efficiency.

Introduction

The manufacturing process transforms the basic product, adding economic value and generating prosperity to the sector, but this cycle often does not apply to the social, economic and environmental dimensions of sustainability. In view of this, a cleaner production approach employed in various processes and segments within an industry in order to increase efficiency in the use of raw materials, water and energy is remarkably increasing. In this scenario, the heat treatment process demands a large amount of energy, besides subjecting the operator to various health and safety risks, such as the inhalation of toxic gases and fire. This project aims to identify in the academic literature the main sustainable practices of this manufacturing process and to study its applications in a company belonging to the area. This work is part of a macro project on sustainability in manufacturing processes coordinated by professors Robert Cooper and Rosley Anholon

Results and Discussion

Initially, a literature review research was carried out in order to obtain the main sustainable practices applied in the heat treatment process. The practices identified were: 1 - Mapping of the energy consumption of the process; 2 - Simple measures aiming at less energy waste, such as: automatic opening of the oven door and maintenance of the refractory; 3 - Heat recovery; 4 - Process simulation tools; 5 - Laser-assisted heat treatment; 6 - Control of the composition of the oven atmosphere; 7 - Substitution of the oil as a quenching medium for a safer and more ecological one; 8 - Actions to prevent fire and against exposure to toxic gases.

Subsequently, a semi-open questionnaire was developed with the purpose of collecting information about the recurrence and difficulty in applying these practices to a company in the area. The questionnaire was submitted and approved by the Unicamp Research Ethics Committee under the number CAAE 02653618.8.0000.5404. From the answers obtained, an analysis could be made comparing what was researched with what is practiced. In relation to practice 1, the company reported that energy mapping is carried out throughout its plant, allowing greater control of consumption, and it was recorded that approximately 60% of its energy consumption is directed to the heat treatment process. In view of this, some actions within practice 2 adopted by the company are: periodic burner maintenance; optimization of the assembly of the loads placed in the furnaces; opening the oven doors automatically together with an individual time counter for each product; and preventive maintenance of furnaces

every 6 months using thermographs in the diagnosis of the refractory lining. The volunteer mentioned that there are devices capable of applying practice 3, but they are difficult to operate and therefore have a high implementation cost, which leads to an unexpected performance. The practice 4, according to the company, is widely used in order to predict the deformations of the parts submitted to the process, thus avoiding waste. Practice 5 is not applied in the company. Allied to practice 2, practice 6 is applied aiming at greater control of the process and the final properties of the product and a better efficiency. The replacement of the quenching oil (practice 7) was shown to be of great interest by the company, conducting several tempering tests performed with water, avoiding one of the greatest fire risks of the process, besides the unhealthy smoke generated by the oil. The company mentioned that preventive and fire-fighting measures are taken but did not detail them. In addition, the company was very concerned about the health and well-being of the worker, with medical visits at the operations stations and daily tests of concentration of toxic gases in the factory. Finally, an analysis can be made of the practices raised and the objectives of the UN Agenda 2030, noting that some of these goals are achieved, more specifically those set out below.



Image 1. UN Sustainable Development Goals - Agenda 2030¹.

Conclusions

The research method used allowed to identify the main sustainable practices applied in the heat treatment process and how they are inserted in a company of the area, creating material that allows the growth of sustainability.

Acknowledgement

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¹ MILLENNIUM, T.; GOALS, D. The Millennium Development Goals Report 2015.